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ABSTRACT

Teaching secondary students the basics of Geographic Information Systems (GIS) results in a variety of benefits. Conventional secondary educational programs are enhanced, and high school students are provided an opportunity to experience a rapidly expanding field as they plan for college and their professional future. For such projects, stipends from mini-grants provided university faculty with extra time to revamp existing courses, create new courses, or set up research and service opportunities for university students. When this education is associated with a "community-based learning" university program, there are additional advantages. Community-based learning (CBL) combines traditional classroom instruction with community service to enhance student learning and civic participation. Thus, not only do the secondary school students gain valuable skills and mentoring, but engaged university students do as well. This paper discusses the successes that emerged, the issues that surfaced, and the lessons that were learned during the testing period of this program in the Department of Geomatics at the University of Alaska Anchorage. Includes photographs and maps. (Contains 10 notes and 5 references.) (Author/BT)

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INTEGRATING GEOGRAPHIC INFORMATION SYSTEMS (GIS) INTO SECONDARY EDUCATION: A COMMUNITY-BASED LEARNING EXPERIENCE

SO 035 166

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Integrating Geographic Information Systems (GIS) into Secondary Education: A Community-based Learning Experience

Abstract: Teaching secondary students the basics of Geographic Information Systems (GIS) results in a variety of benefits. Conventional secondary educational programs are enhanced, and high school students are provided an opportunity to experience a rapidly expanding field as they plan for college and their professional future. When this education is associated with a "Community-based Learning" university program, there are additional advantages. Community-based learning (CBL) combines traditional classroom instruction with community service to enhance student learning and civic participation. Thus, not only do the secondary school students gain valuable skills and mentoring, but engaged university students do as well. This paper discusses the successes that emerged, the issues that surfaced, and the lessons that were learned during the testing period of this program in the Department of Geomatics at the University of Alaska Anchorage.

Key Words: *GIS, secondary students, university students, Community-Based Learning*

INTRODUCTION

Three years ago the University of Alaska Anchorage (UAA) created the Center for Community Engagement and Learning, whose mission is to facilitate and integrate university programs with various civic partnerships and projects. [1] Community-Based Learning (CBL) mini-grants were offered to UAA faculty and researchers in order to establish teaching or research partnerships with community groups—typically those that are under-resourced. Stipends from the mini-grants were made available to provide faculty extra time to revamp existing courses, create new courses, or set up research and service opportunities for university students. The goal of this program in the university was NOT to become another social agency promoting extracurricular volunteerism such as working a few hours a week in a soup kitchen, but rather to allow university students to take what they learn in the classroom and apply it to a real world situation. This can take the form of teaching, presentations, or doing research on a specific problem that benefits certain segments of society. Since these experiences often imitate what students will face when they join the workforce, the benefits are multi-directional.

For more than twenty years, I have been engaged in university outreach to combat "geographic illiteracy" among the K-12 population. I have created and presented a variety of geography and mapping projects to elementary and secondary students as well as orchestrated geography in-service days for teachers. Initially I assumed the CBL program would be fairly analogous to my previous outreach experiences, but that was not the case as there are distinct differences between outreach and CBL. Because CBL explicitly engages university students and because their experiences are later described and discussed in a reflection document—there is a much stronger pedagogic component[2] than pure outreach affords. University students are drawn into the project and are given an opportunity to immerse and apply themselves in subjects that they have long spent studying. Classroom and textbook theory is now put into practice, and by application they are tested (as is reiterated time and time again in their class evaluations) much more rigorously than in the typical university classroom. Additionally, I have found that my role as professor has evolved into more of a facilitator, wherein university students are encouraged to stretch their wings (although sometimes I think they feel more like they have been "pushed out of the nest without even a parachute" than given a flying lesson).

Currently, my teaching assignments at the university revolve around GIS and cartography, so for the mini-grant I chose to develop a CBL project that adapted these subjects to curriculum and study units for secondary school students. Because my students are entering the final phases of their GIS degree program,

their skills in working with GIS are now quite broad. The course that I incorporated CBL into is a senior level class, GIS 458 Design and Management of Spatial Data. Topically the class focuses on project management, GIS implementation in an organization, personnel and data organization, legal issues involving data and information, metadata, and spatial data standards. Other goals of the class are to foster a team approach and provide practice in development and delegation of tasks, accountability and the myriad issues regarding implementation of a GIS system within an organization[3] .

YEAR ONE

The first class incorporating CBL as part of the curriculum was during spring semester 2001. I had been approached by an Anchorage middle school teacher, who was interested in introducing his computer technology classes to GIS. He did not have access to GIS software nor was he trained in its use, but he felt his seventh and eighth-grade students would benefit from exposure to GIS. Ultimately I was able to get ESRI[4] to donate an educational package of ArcView 3.2, and Aeromap, Inc. provided a digital composite color airphoto (1"=3000') of south Anchorage, which included the middle school and surrounding area.

My five upper division students and I spent the first several weeks of the spring semester discussing GIS project management, implementation issues, and other aspects that professionals encounter in this field. We also met with the middle school teacher in order to better understand his students. They were characterized as being relatively high achievers from one of the more affluent areas of Anchorage. My students began working as a team to develop a GIS implementation plan for their computer lab, and different topics were devised that would provide the middle school students with a coherent and logical introduction to GIS using local (and therefore more relevant) data and resources. The last several weeks of the semester were slated for in-class presentations and labs, which lasted approximately 40 minutes each. Each week we commuted about one hour round trip to the middle school, where one UAA student would make his/her Powerpoint presentation and then walk the students through the GIS exercise. The four other student team members would move through the room assisting the 30-odd middle school students individually.

I think we all (including the teacher) believed that most of the students would become motivated to work through the exercises. And, while a couple of the students actually focused on the lessons and worked completely through the labs, the majority of them were simply not interested. On more than one occasion, they even told us as much. This pervasive indifference was very disturbing to me and my students. Yet, despite a basically unwilling audience, every week my students returned to UAA to regroup and brainstorm and try to

find a way to accomplish their mission. Probably the most effective solution was incorporating more graphics, sound, video clips and the "romance and adventure"[5] of mapping into the presentations.

Sadly, my students felt they had been pretty ineffective, though I did not see it that way. One of the benefits of their CBL project was the chance to experience adversity firsthand and devise a means to respond to it. They had been thrust directly into a real world circumstance that could be similar to one they might face someday in their professional lives. Not all workplace situations go smoothly and without hitches, and the lessons they learned in that middle school classroom have hopefully prepared them for facing similar challenges.

YEAR TWO

Although I had made up my mind not to commit my spring 2002 class and students to s similar experience again, I ultimately changed my mind and approached the situation differently. A few months earlier, I had met with Mike Woods, a high school teacher who teaches natural resources classes at King Career Center (KCC)[6]. Mike is an energetic, talented, and enthusiastic teacher, who brings real world experience to his classroom and students. His curriculum includes map reading, coordinate systems, compass and GPS usage, and a variety of topics on wildfire, forestry, riparian habitats, and wildlife. He, too, felt that the addition of GIS into his program would be greatly beneficial to his students. Since KCC is located within walking distance of the UAA campus, several logistical problems were resolved. Most importantly, there was easy access for his students to our GIS-equipped computer labs. This meant no more time lost commuting, and concerns about loading data, mapping the network drives (a weekly occurrence), and "mysteriously missing" software were basically eliminated. Mike and I discussed the collaboration, and a decision was made to work with a small group of hand-picked high school juniors and seniors These students would begin the GIS training with a good grounding in maps and map reading, and we would extend the training period from 40 minutes to over three hours per session. The grant proposal was approved for implementation in spring 2002.

The reputation of the previous year's GIS 458 class had not escaped my five entering senior students. We openly discussed what had happened and how I hoped that we would have a different outcome. Mike Woods selected five students, two seniors and three juniors—one a female. The criteria for selection focused on scholarship, responsibility, and the probability of a successful outcome. Mike had specific expectations for the students, and they knew it. This opportunity was not to be an excuse to be out of regular class, rather they were

to learn, complete assignments, and be able to convey what they had learned to their classmates who remained at KCC. Further adding to the challenge was that we only had five weeks to accomplish our goal of teaching them basic GIS functionality.

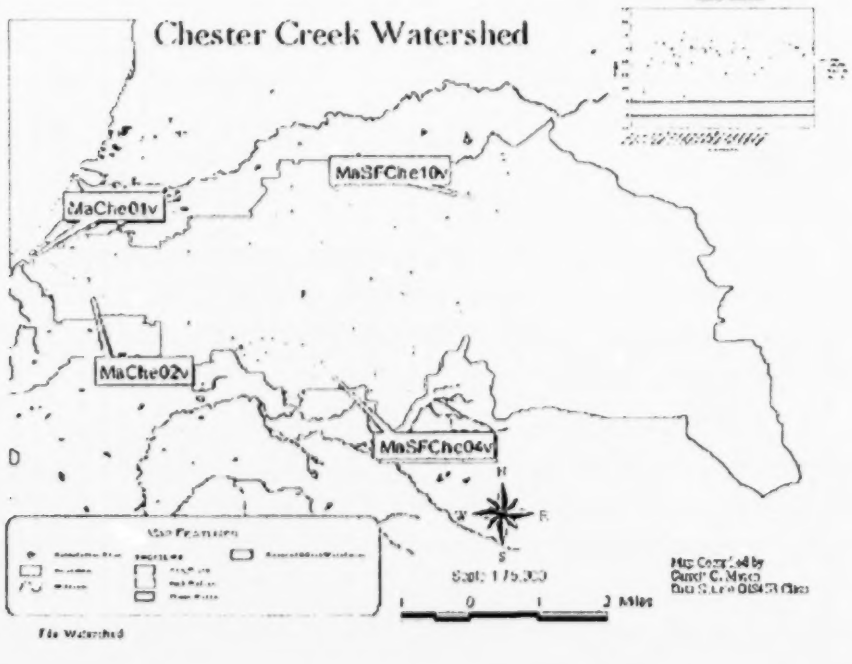
On the first class day with the KCC students, they seemed a bit reserved as we went through introductions, but soon warmed up and began answering and asking questions. My students had decided to set up a series of study units that related to environmental issues—since this was a common link to the KCC natural resources class. Additionally, the lessons were to use Anchorage or Alaska data rather than the "canned" data and exercises that are typically available as GIS tutorials. The initial lesson was a group presentation that provided the fundamentals and principles necessary to understand many of the upcoming GIS components. Basic topographic map reading was reviewed, and presentations were made on thematic and general reference maps, map projections and coordinate systems, datums and ellipsoids, map symbolization, metadata, what GIS is, and careers in GIS. At the end of the first class, the KCC students were given about 30 minutes to peruse some of the websites that have GIS-like capabilities and then to respond to a few assigned questions.

Jason Graham (right) assisting KCC student Cody Thompson

There was no doubt among my students that the three+ hours of the first class were going to be the "driest" of the lessons. If they could manage to hold the KCC students' attention for this part, they knew the remaining classes would be fine. They not only held their attention, but at the end of the first class the KCC students very politely thanked everyone and said they looked forward to the next week. My students met afterwards to assess the situation, and they were all very positive about the experience. For the most part, it had been their first real exposure to teaching, which they found to be intimidating and challenging in terms of preparation, time allocation, organization, and presentation. Progress on the upcoming modules was reviewed, and plans were put into place for the ensuing lessons. One requirement I had was that the lessons were to be available in advance so that their classmates could do a trial run and provide critical feedback. Comments needed to focus on questions such as:

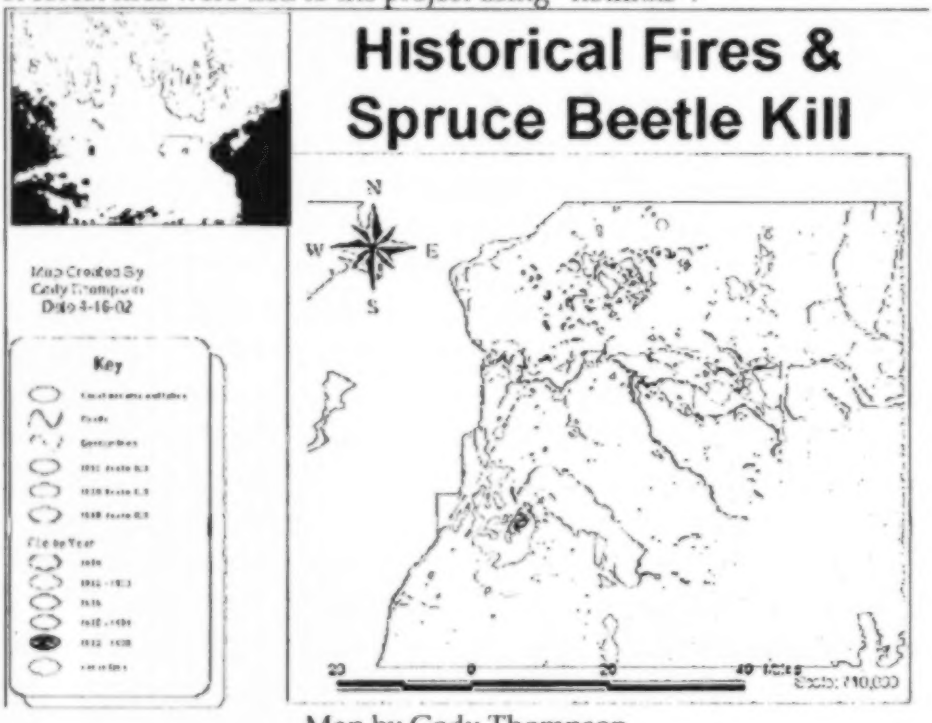
> Were the step-by-step directions clear (text and screenshots)?
> Did the lab progress logically?
> What were the outcomes of the exercise?

The second lesson was a project on Anchorage's watersheds. Within this module, there was a basic introduction to the ArcView 3.2 interface and tools, layers, symbolization, and attribute tables. At the conclusion, students were asked to answer questions that concerned the watershed project.



Map by Garrett C. Myren

The third week focused on the spruce bark beetle and wildfire hazard in Southcentral Alaska area. Parts of Alaska have been severely impacted by this pest, and the result is thousands of acres of dead spruce trees that are highly susceptible to wildfire. This project encompassed clipping map layers, buffering roads, conversion of vector data to a grid, and creation of a 3-D model. Finally, tiffs of forest fires were tied to the project using "hotlinks".



Map by Cody Thompson

The fourth class consisted of a lesson that culminated in the importation and geo-location of Aleutian volcanoes from a table on a U.S.G.S. internet site[7]. Metadata[8] and coordinate system information were reinforced, and the volcanoes were dropped on top of a Digital Raster Graphic (DRG) after being reprojected to the UTM[9] coordinate system. The second part of this class period was an introduction to heads-up digitizing using a georeferenced digital air photo of the UAA campus.

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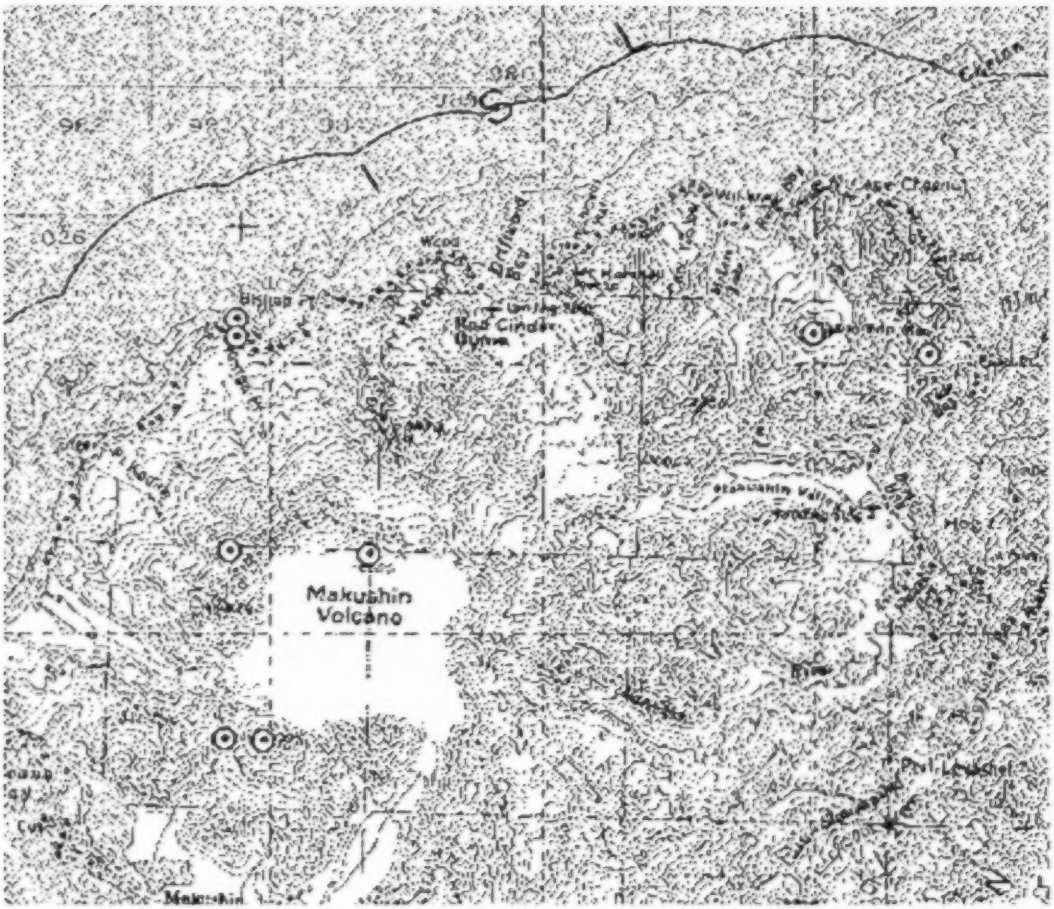

Aleutian Volcano Project (the circled dots are the added volcano locations)

The last class with KCC was devoted to helping the students bring screen shots and jpegs of their projects into separate PowerPoint presentations to show to their classmates later that morning. The KCC GIS students were supposed to explain what they had done during the last few weeks at UAA and try to elicit enthusiasm so that their classmates would want to continue in subsequent classes. My students assisted the KCC students with their presentations, which were remarkable considering the short time that had to learn GIS—barely 15 hours!

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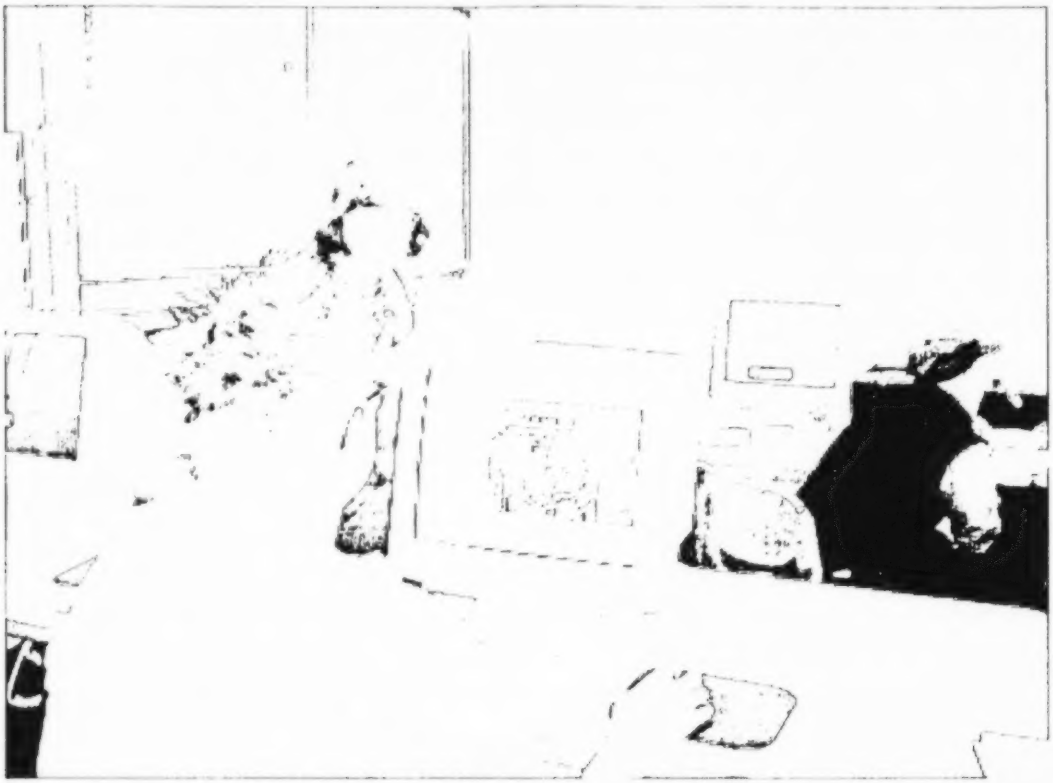

Amy Puerner assists Jason Mercer with his PowerPoint presentation

Everyone, especially Mike Woods, was impressed, and a small reception was held for all the students afterwards. Several students who had not participated came up to me and said they were hoping to be in the GIS class next time.

YEAR THREE

The positive experience of the second class convinced me to continue with Mike Woods' students during spring 2003. Working out the extended class hours from 2 hours to nearly 3.5 was problematic (and required several layers of permissions), however 4 KCC students committed to take the GIS class. This time I had six UAA students to hand the reigns over to, and they proceeded to devise a course of study. It was interesting to me that their approach was somewhat different from the previous year's class. Though most of the same topics were covered, the order of presentation varied as did the emphasis on detail.

Having the benefit of hindsight from the two previous years, I had a fairly goo feel for the amount and type of information that holds attention during the "lectures". In five weeks, there was not enough time (nor interest) to go into great detail over topics such as map projection mechanics, statistical analysis a theory of natural breaks, etc. Additionally, it had been demonstrated previou that fewer words and more graphics is a better way to go. Maps are very visu and it is better to illustrate a point with a graphic and three short "bullets" tha no graphic(s) and several paragraphs in a PowerPoint. Even though I felt that couple of students in this group might be a bit overly ambitious in terms of wh they wanted to impart, I only occasionally stepped in with suggestions. Their colleagues did a good job in working to have the lessons reduced in detail, though there were often some intense discussions and major disagreements. I interesting to note that my students were actually pretty rigid in terms of their expectations—which were very high.

Having six UAA students in this class meant a more diverse group in terms of personality. One student in particular began to rise as a take-charge type, and oftentimes the other group members deferred rather passively. As the instruc it can be difficult to walk the fine line of facilitation and interference, so I did m best to not intervene. Finally, one of the more compliant students figured out that I was not going to step in (even though asked to), and he began to be mor assertive in the decision making processes. To me, this was one of the benefits teaching a CBL class. Later he wrote in his reflection paper,

> [M]anagement is not just about telling people what to do or being able to perform well under pressure. Management is the ability to understand your environment and all that is found within and with that understanding being able to make decisions that make the system work smoothly while keeping face and keeping the moral levels elevated...Each classmate listened to the others well, returned feelings with a criticism at a professional level, and, at the same time, the receiver was able to take the criticism and use it to their advantage...I can say with confidence that I understand fully what Dr. Cherie Northon meant when she aid, "This is your class!"--Daniel Seamount

CONCLUSIONS

What were some differences between the three CBL experiences? Generally, a perhaps most importantly, working with the KCC high school students was highly successful and made up for the perceived failures of the first year. In retrospect, I attribute this to working with a smaller and more mature group o students who had a good background in related topics and an incredible teach

with high expectations. The KCC students were attentive, polite, and well-mannered (even my students commented several times on how their perceptions of high school students had been altered dramatically by this experience). Often during the three and a half hour classes I had to force them to stop, get up, and take a short break—they were so engrossed that they wanted to keep working. And, after every class, they graciously thanked us for the time we had spent with them.

What did I learn? One of the questions I had was whether or not secondary school students could work with and absorb a fairly complex software package and associated projects. Many of the important concepts that underlie GIS such as projections, datums, ellipsoids, and data and spatial analysis were presented to them in an overview format, and yet they ended up with a good grasp of the material.

What did my students gain? During the semester they were required to keep a reflection journal (part of the CBL experience) that they would later use to construct a final essay on their experience. From their writings it is evident that they unanimously agreed that teaching a class meant quite a challenge to their public speaking and organizational skills and of how well they knew GIS as opposed to how well they thought they knew it. Another realization was just how long it takes to prepare presentations, step-by-step tutorials, and lab exercises and how much detail is necessary (finally some recognition for prep time!). Lastly, I think it really drove home how similar the activities they engaged in could be to professional situations in future work environments. This was not an exercise to convince them to be (or not be) teachers, rather it was an opportunity to mimic workplace situations. They were given a good practical experience in working as a team and in finding out what areas of their GIS background might need reinforcement. They realized that they could not face the KCC students unless they were well-prepared, organized, and ready to field questions spontaneously. They needed to have answers or find a means of getting the answers. It was likened to studying for a test each week in order to be prepared for the KCC students. Working with GIS is one thing, explaining it and fielding questions is another. And, perhaps one of the side benefits was that they gained a new appreciation for what any of us who have ever taught realized—it is not an easy profession.

How did the KCC students feel? "It completely blew away my expectations. I have NEVER had so much fun learning." As for what needed improvement, one student wrote, "I say leave it alone [as] it was as perfect as it could get. The only thing is I would have extended it if it were possible for 1 or 2 or 3 more weeks, but otherwise it was perfect". All students agreed that they wanted more time learning GIS.

What did the KCC students gain? They were able to see the integration of their natural resource studies with powerful tools of mapping and spatial analysis. It also gave them first-hand experience in a rapidly growing professional field while also letting them get a feel for attending a university. Finally, their learning experience was expanded by participating in a university setting. One of the two seniors from the spring 2002 class remained in Anchorage and is attending UAA GIS classes rather than follow his plans to attend another university.

There are many reasons to consider for implementing a program that includes CBL. One is NOT to find out if younger students can grasp complex GIS concepts as this has been aptly demonstrated before[10]. So, why do it? Outreach is an important aspect of student recruitment. Geographers know all too well that most youngsters if asked what they want to be when they grow up--do not answer that they want to be a geographer or a GIS analyst. We need to familiarize the public with our discipline and some of its many valuable tools. Another important reason is that this type of program provides valuable resources and expertise to schools and teachers who do not have access to GIS. The right group of students can have a wonderful experience of discovery, excitement, and accomplishment, which enhances their view of learning. GIS is so different from their daily school routine that they hardly realize they are involved in learning. And finally, it is an excellent method for reinforcing many of the concepts and learning by our university students.

Will CBL continue as part of our GIS curriculum. There is no question that it will. As long as I have the opportunity to partner with conscientious, energetic, and involved teachers, such as Mike Woods, this will continue to be a part of the senior GIS curriculum. It is also a valuable experience that I think all graduating GIS students should have.

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[1]Established in 2000 by the University of Alaska Board of Regents, the Center for Community Engagement & Learning builds upon the University's community service mission. This Center serves as a clearinghouse for faculty interested in community-based learning and research; a front door to the University of community leaders with project ideas, proposals, and needs; a catalyst for students seeking academic engagement beyond the traditional classroom; and a promoter and generator of participatory action research to help meet applied research needs of the community.

[2] See Barbara Jacoby's *Service-Learning in Higher Education* (1996), Edward Zlotkowski's "Pedagogy and Engagement" in *Colleges and Universities as Citizens* (1999), or Campus Compact's *Introduction to Service-Learning Toolkit* (2000) for a detailed account of the CBL pedagogy.

[3] The text used for this portion of the class is Huxhold and Levinsohn's *Managing Geographic Information System Projects* (1995)

[4] Environmental Systems Research Institute, Inc. (ESRI) is one of the major market leaders in GIS. Their software includes the long-lived Arc/Info, ArcView and ArcGIS products.
[5] One student had some photos of hydrographic mapping that were taken on a boat, and he used music from Gilligan's Island as accompaniment. Another student showed a person mapping from a helicopter. Rapt attention was paid by the audience—at least for a short time.
[6] King Career Center teaches optional high school classes that provide students with experience in specialized subjects, such as broadcasting, natural resource management, culinary arts, and horticulture. Students who attend travel from their home high school for 2-hour classes.
[7] http://eq.giseis.alaska.edu/genrl_info/voltable.html
[8] Metadata is "data about the data". It provides GIS users with the information that is necessary to combine data sets and allows the assessment of a data set in terms of accuracy and completeness.
[9] Universal Transverse Mercator
[10] See Audet and Ludwig's *GIS in Schools* (2000) for several examples of elementary and secondary school projects—some quite sophisticated.

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